

CHAPTER 5. TACAN, VOR/DME, AND VOR WITH FAF

500. GENERAL. This chapter applies to approach procedures based on the elements of the VORTAC facility; i.e., VOR, VOR/DME, and TACAN, in which a final approach fix (FAF) is established. The chapter is divided into two sections; Section 1 for VOR procedures which do not use DME as the primary method for establishing fixes, and Section 2 for VOR/DME and TACAN procedures which use collocated, frequency paired DME as the sole method of establishing fixes. When both the VOR and TACAN azimuth elements of a VORTAC station will support it, a single procedure, identified as a VOR/DME or TACAN shall be published. Such a procedure may be flown using either a VOR/DME or TACAN airborne receiver and shall satisfy TACAN terminal area fix requirements. See Paragraph 286.d.

501. – 509. RESERVED.

Section 1. VOR with FAF

510. FEEDER ROUTES. Criteria for feeder routes are contained in Paragraph 220.

511. INITIAL APPROACH SEGMENT. Criteria for the initial approach segment are contained in Chapter 2, Section 3. See Figures 44 and 45.

512. INTERMEDIATE APPROACH SEGMENT. Criteria for the Intermediate approach segment are contained in Chapter 2, Section 4. See Figures 44 and 45.

513. FINAL APPROACH SEGMENT. The final approach may be made either "FROM" or "TOWARD" the facility. The final approach segment begins at the final approach fix and ends at the runway or missed approach point, whichever is encountered last.

a. Alignment. The alignment of the final approach course with the runway centerline determines whether a straight-in or circling-only approach may be established. The alignment criteria

differs depending on whether the facility is OFF or ON the airport. See definitions in Paragraph 400.

(1) Off-Airport Facility.

(a) Straight-In. The angle of convergence of the final approach course and the extended runway centerline shall not exceed 30 degrees. The final approach course should be aligned to intersect the runway centerline at the runway threshold. However, when an operational advantage can be achieved, the point of intersection may be established as much as 3000 feet outward from the runway threshold. See Figure 46.

(b) Circling Approach. When the final approach course alignment does not meet the criteria for a straight-in landing, only a circling approach shall be authorized, and the course alignment should be made to the center of the landing area. When an operational advantage can be achieved, the final approach course may be aligned to any portion of the usable landing surface. See Figure 47.

(2) On-Airport Facility.

(a) Straight-In. The angle of convergence of the final approach course and the extended runway centerline shall not exceed 30 degrees. The final approach course should be aligned to intersect the extended runway centerline 3000 feet outward from the runway threshold. When an operational advantage can be achieved, this point of intersection may be established at any point between the threshold and a point 5200 feet outward from the threshold. Also, where an operational advantage can be achieved a final approach course which does not intersect the runway centerline, or which intersects it at a distance greater than 5200 feet from the threshold, may be established, provided that such a course lies within 500 feet laterally of the extended runway centerline at a point 3000 feet outward from the runway threshold. See Figure 48.

(b) Circling Approach. When the final approach course alignment does not meet the crite-

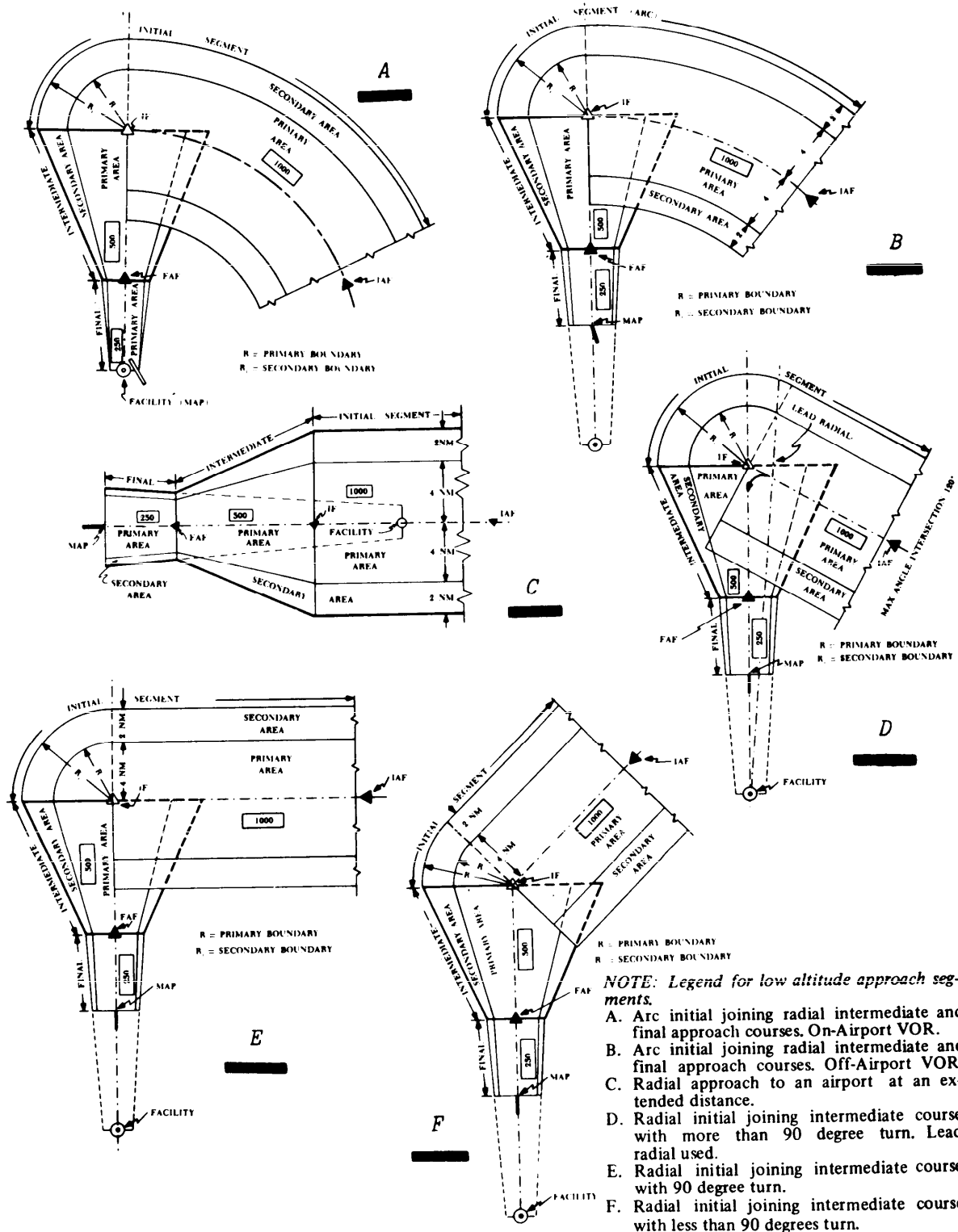


Figure 44. TYPICAL LOW ALTITUDE APPROACH SEGMENTS. VOR with FAF. Par 511 and 512.

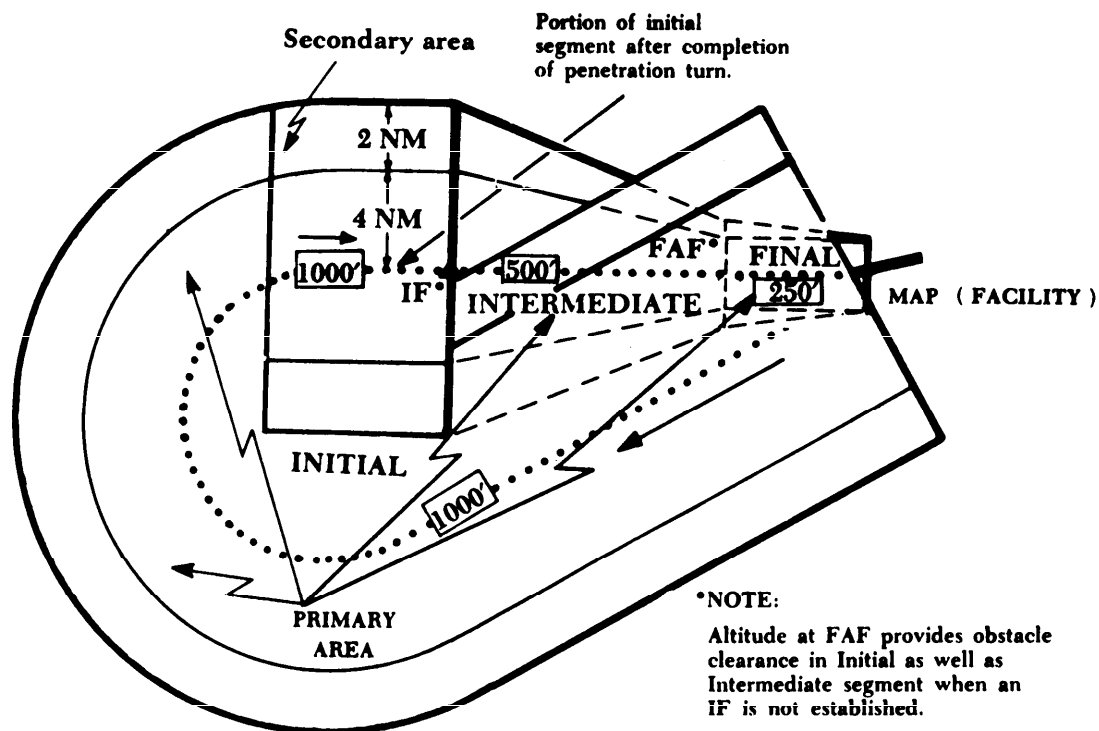


Figure 45. TYPICAL HIGH ALTITUDE SEGMENTS. VOR with FAF. Par 511 and 512.

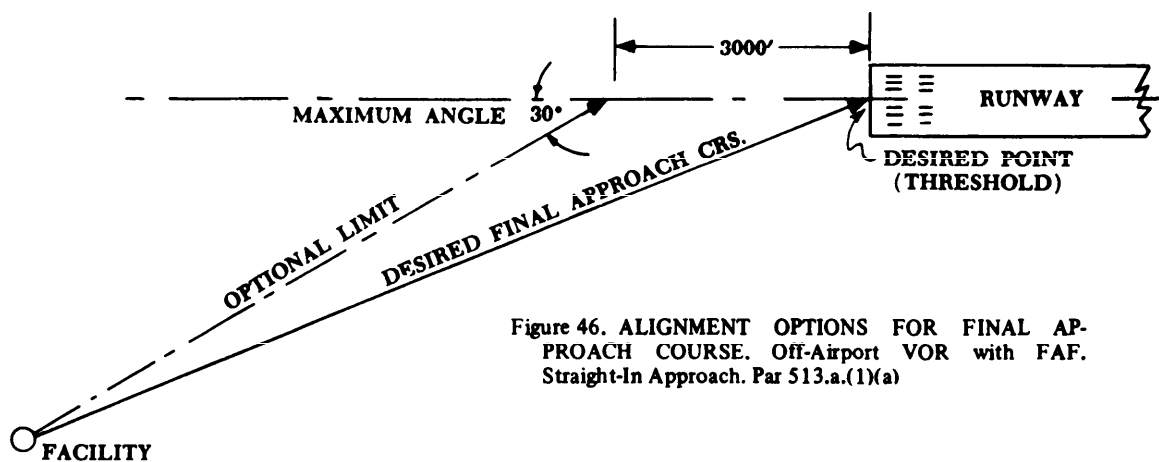
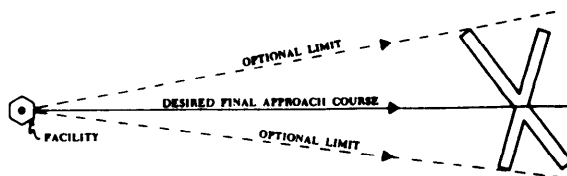


Figure 46. ALIGNMENT OPTIONS FOR FINAL APPROACH COURSE. Off-Airport VOR with FAF. Straight-In Approach. Par 513.a.(1)(a)

Figure 47. ALIGNMENT OPTIONS FOR FINAL APPROACH COURSE. Off-Airport VOR with FAF. Circling Approach. Par. 513.a.(1)(b).



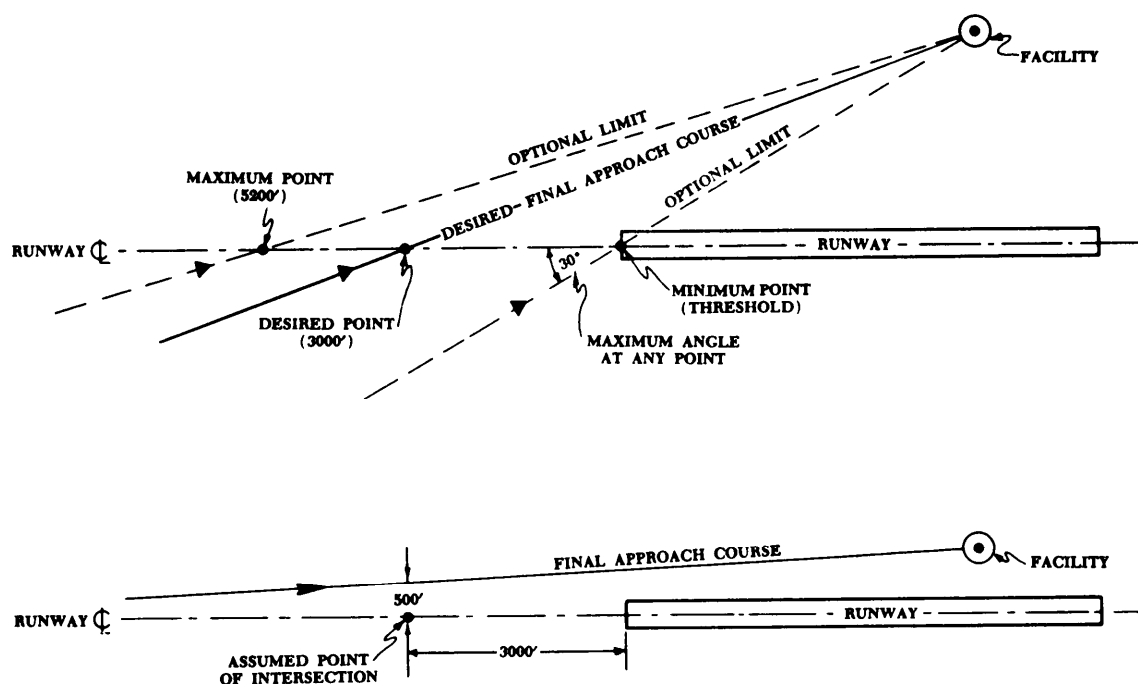


Figure 48. ALIGNMENT OPTIONS FOR FINAL APPROACH COURSE. On-Airport VOR with FAF. Straight-In Approach. Par 513.a.(2)(a)

ria for a straight-in landing, only a circling approach shall be authorized, and the course alignment should be made to the center of the landing area. When an operational advantage can be achieved, the final approach course may be aligned to any portion of the usable landing surface. See Figure 49.

b. Area. The area considered for obstacle clearance in the final approach segment starts at the final approach fix and ends at the runway or missed approach point, whichever is encountered last. It is a portion of a 30-mile long trapezoid (see Figure 50) which is made up of primary and secondary areas. The primary area is centered longitudinally on the final approach course. It is 2 miles wide at the facility, and expands uniformly to 5 miles wide at 30 miles from the facility. A secondary area is on each side of the primary area. It is zero miles wide at the facility and expands uniformly to 1 mile on each side of the primary area at 30 miles from the facility. Final approaches may be made to airports which are a maximum of 30 miles from the facility. See Figure 51. The OPTIMUM length of the final approach segment is 5 miles. The MAXIMUM length is 10 miles. The MINIMUM length of the final approach

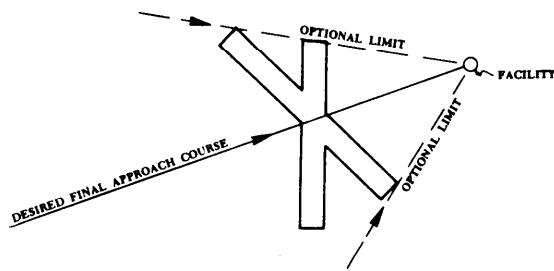


Figure 49. ALIGNMENT OPTIONS FOR FINAL APPROACH COURSE. On-Airport VOR with FAF. Circling Approach. Par 513.a.(2)(b).

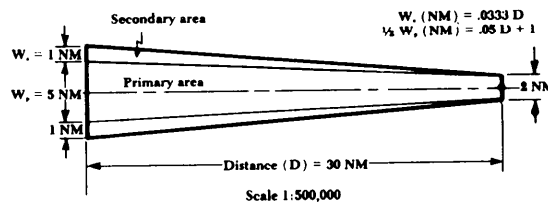


Figure 50. FINAL APPROACH TRAPEZOID. VOR with FAF. Par 513.b.

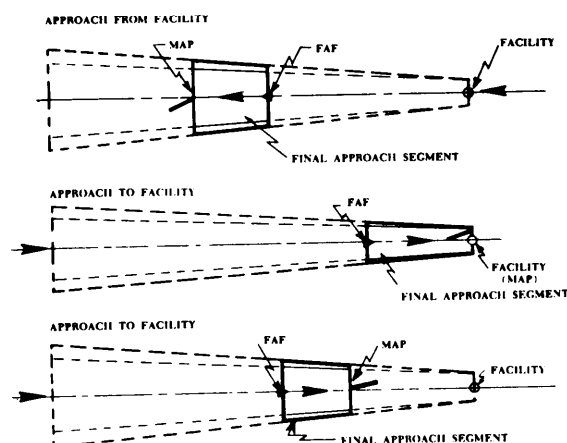


Figure 51. TYPICAL STRAIGHT-IN FINAL APPROACHES. VOR with FAF. Par 513.b.

segment shall provide adequate distance for an aircraft to make the required descent, and to regain course alignment when a turn is required over the facility. Table 14 shall be used to determine the minimum length needed to regain the course.

c. Obstacle Clearance.

(1) **Straight-In Landing.** The minimum obstacle clearance in the primary area is 250 feet. In the secondary area 250 feet of obstacle clearance shall be provided at the inner edge, tapering uniformly to zero feet at the outer edge. The minimum obstacle clearance at any given point in the secondary area is shown in Appendix 2, Figure 125.

(2) **Circling Approach.** In addition to the minimum requirements specified in Paragraph 513.c.(1) above, obstacle clearance in the circling area shall be as prescribed in Chapter 2, Section 6.

d. Descent Gradient. The **OPTIMUM** descent gradient in the final approach segment should not exceed 300 feet per mile. Where a higher descent gradient is necessary, the **MAXIMUM** permissible gradient is 400 feet per mile. See also Paragraphs 251 & 288.a.

(1) **Straight-In Approach.** The descent gradient shall be computed using the distance from the FAF to the runway threshold and the difference in altitude between the altitude over the FAF and the touchdown zone elevation.

Table 14. MINIMUM LENGTH OF FINAL APPROACH SEGMENT-VOR (MILES)

Approach Category	Magnitude of Turn over the Facility (Degrees)		
	10	20	30
A	1.0	1.5	2.0
B	1.5	2.0	2.5
C	2.0	2.5	3.0
D	2.5	3.0	3.5
E	3.0	3.5	4.0

NOTE: This table may be interpolated. If the minimum lengths specified in the table are not available, straight-in minimums are not authorized. See Figure 51 for typical final approach areas.

(2) **Circling Approach.** The descent gradient shall be computed using the distance from the FAF to the first usable portion of the landing surface and the difference in altitude between the altitude over the FAF and the circling MDA.

e. Use of Fixes. Criteria for the use of radio fixes are contained in Chapter 2, Section 8. Where a procedure is based on a procedure turn and an on-airport facility is the procedure turn fix, the distance from the facility to the FAF shall not exceed 4 miles.

f. Minimum Descent Altitudes. Criteria for determining the MDA are contained in Chapter 3, Section 2.

514. MISSED APPROACH SEGMENT. Criteria for the missed approach segment are contained in Chapter 2, Section 7. For VOR procedures, the missed approach point and surface shall be established as follows:

a. Off-Airport Facilities.

(1) **Straight-In.** The missed approach point is a point on the final approach course which is NOT farther from the final approach fix than the runway threshold. (See Figure 52.) The missed approach surface shall commence over the missed approach point at the required height. See Paragraph 274.

(2) **Circling Approach.** The missed approach point is a point on the final approach course which is NOT farther from the final approach fix than the first usable portion of the landing area. The missed approach surface shall commence over the

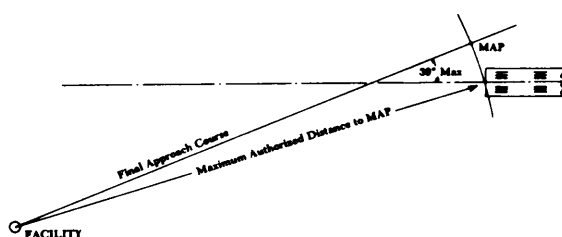


Figure 52. MISSED APPROACH POINT. Off-Airport VOR with FAF. Par 514.a.(1)

missed approach point at the required height. See Paragraph 274.

b. On-Airport Facilities. The missed approach point is a point on the final approach course which is NOT farther from the final approach fix than the facility. The missed approach surface shall commence over the missed approach point at the required height. See Paragraph 274.

515. – 519. RESERVED.

Section 2. TACAN and VOR/DME

520. FEEDER ROUTES. Criteria for feeder routes are contained in Paragraph 220.

521. INITIAL SEGMENT. Due to the fixing capability of TACAN and VOR/DME a procedure turn initial approach may not be required. Criteria for initial approach segments are contained in Chapter 2, Section 3.

522. INTERMEDIATE SEGMENT. Criteria for the intermediate segment are contained in Chapter 2, Section 4.

523. FINAL APPROACH SEGMENT. TACAN and VOR/DME final approaches may be based either on arcs or radials. The final approach begins at a final approach fix and ends at the missed approach point. The missed approach point is always marked with a fix.

a. Radial Final Approach. Criteria for the radial final approach are specified in Paragraph 513.

b. Arc Final Approach. The final approach arc shall be a continuation of the intermediate arc. It

shall be specified in nautical miles and tenths thereof. Arcs closer than 7 miles (15 miles for high altitude procedures) and farther than 30 miles from the facility shall NOT be used for final approach. No turns are permitted over the final approach fix.

(1) Alignment. For Straight-in approaches, the final approach arc shall pass through the runway threshold when the angle of convergence of the runway centerline and the tangent of the arc does not exceed 15 degrees. When the angle exceeds 15 degrees the final approach arc shall be aligned to pass through the center of the airport and only circling minimums shall be authorized. See Figure 53.

(2) Area. The area considered for obstacle clearance in the arc final approach segment starts at the final approach fix and ends at the runway or missed approach point, whichever is encountered last. It should NOT be more than 5 miles long. It shall be divided into primary and secondary areas. The primary area is 8 miles wide, and extends 4 miles on either side of the arc. A secondary area is on each side of the primary area. The secondary areas are 2 miles wide on each side of the primary area. See Figure 54.

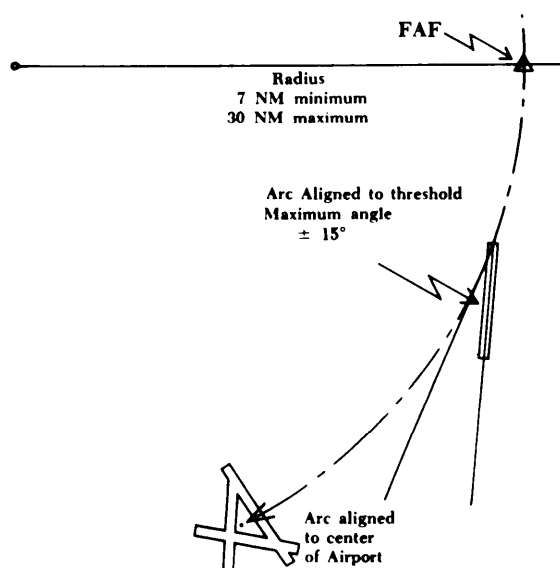


Figure 53. ARC FINAL APPROACH ALIGNMENT. Arc Aligned to Threshold. TACAN or VOR/DME. Par 523. b.(1)

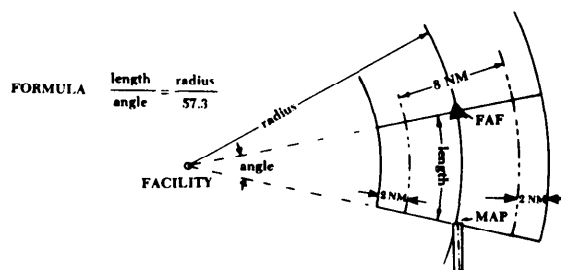


Figure 54. ARC FINAL APPROACH AREA. TACAN or VOR/DME. Par 523.b.(2)

(3) **Obstacle Clearance.** The minimum obstacle clearance in the primary area is 500 feet. In the secondary area, 500 feet of obstacle clearance shall be provided at the inner edge, tapering uniformly to zero feet at the outer edge. The minimum required obstacle clearance at any point in the secondary area is shown in Appendix 2, Figure 123.

(4) **Descent Gradient.** Criteria for descent gradients are specified in Paragraph 513.d.

(5) **Use of Fixes.** Fixes along an arc are restricted to those formed by radials from the VORTAC facility which provides the DME signal. Criteria for such fixes are contained in Chapter 2, Section 8.

(6) **Minimum Descent Altitude.** Straight-in MDAs shall not be specified lower than circling for arc procedures. Criteria for determining the circling MDA are contained in Chapter 3, Section 2.

524. MISSED APPROACH SEGMENT. Criteria for the missed approach segment are contained in Chapter 2, Section 7. The missed approach point shall be a radial/DME fix. The missed approach surface shall commence over the fix and at the required height. (Also See Paragraph 514.)

NOTE: The arc missed approach course may be a continuation of the final approach arc.

525. – 599. RESERVED.